CLAIMS

What is claimed is:

1. An automated call routing system, comprising:

an automated call routing component to route incoming calls to members of an organization and providing automated responses to one or more callers; and

a decision model associated with the automated call routing component to mitigate transferring the calls to an operator.

2. The system of claim 1, further comprising a speech recognition component for communicating with the callers.

3. The system of claim 1, the decision model is trained from a data log that has recorded data of past activities and interactions with the call routing component.

4. The system of claim 3, the data log contains data relating to at least one of a Speaker Found, a Speaker Not Found, an OperatorRequest, a Help Request, a Hang Up, a Maximum number of Errrors, a Not Ready indication, and an Undefined category.

5. The system of claim 1, the decision model processes one or more dialog features including at least one of system and user actions, session summary features, *n*-best recognitions features, and generalized temporal features.

6. The system of claim 5, the *n*-best recognitions features are derived from a speech recognizer, and the generalized temporal features are included to cover trends between one or more *n*-best lists.

7. The system of claim 1, the decision model employs a probability tree determining a likelihood of success given a sequence of system actions.

8. The system of claim 7, the decision model determining *p(SpeakFound|E)*, wherein observational evidence *E* refers to system actions taken, by counting a number of logged cases along an action sequence that resulted in success over a total number of cases along the sequence, wherein *p* is a probability.

9. The system of claim 1, decision model employs a dependency network that processes one or more categories of dialog features as input variables.

10. The system of claim 9, the decision model processes at least one of a sequence of system actions, a count or number of alternates in an *n*-best recognitions list, a number of times a user attempted to speak a name, a largest score assigned by a call routing system, and a number of dialog turns – defined as a question-answer pair.

11 ~~12~~. The system of claim 1, the decision model employs a Markov Dependency network.

12 ~~13~~. The system of claim 12, further comprising a component to increase an amount of data in order to boost a partial model for dialog turns over a marginal model.

13 ~~14~~. The system of claim 1, the decision model includes probabilistic models to perform dynamic decisions about costs and benefits of shifting a caller to a human operator.

14 ~~15~~. The system of claim 14, the probabilistic models provide predictions about outcomes to enable administrators of automated call routing systems to specify preferences regarding the transfer of callers to a human operator.

15 ~~16~~. The system of claim 15, the preferences are represented as a tolerated threshold on failure as a function of a current expected time that callers have to wait for a human operator, given a current load on operators. The probabilistic models can also be employed in call center design.

16 ~~17~~. The system of claim 1, the decision model is employed to facilitate staffing decisions by taking into consideration at least one of probabilistic performance of an automated system to route calls successfully, preferences about wait time, characterization of caller volumes, and time required for addressing callers in a queue waiting for an operator.

17 ~~18~~. The system of claim 17, the queue is optimized based on a queue-theoretic formulation.

18 ~~19~~. A computer readable medium having computer readable instructions stored thereon for implementing at least one of the call routing component and the decision model of claim 1.

19 ~~20~~. A system that facilitates call routing, comprising:

means for interacting with a caller;

means for automatically directing the caller to a user; and

means for performing a decision theoretic analysis before directing the caller to a user, the decision-theoretic includes a cost benefit analysis weighing the benefits of transferring the caller to an operator.

20 ~~21~~. A method for automatically routing calls, comprising:

determining a utility model for employment with a call routing system;

training the utility model from a log of past system call activities; and

automatically directing calls to at least one of an organization member and an operator.

21 ~~22~~. The method of claim 21, the utility model is applied to a user function, $u(n,m,w)$, associated with a process of call routing, the user function is a function of a number of automated dialog steps taken, n, a total expected number of steps that will be taken with an automated routing system, m, and a wait time, w, for transferring to a human operator.

22 ~~23~~. The method of claim 22, further comprising processing user frustrations.

23 ~~24~~. The method of claim 22, further comprising processing negative emotional reactions to working with an automated system versus a human operator.

24 ~~25~~. The method of claim 22, further comprising performing a cost-benefit analysis of routing actions under uncertainty, considering a number and nature of at least one step in a dialog.

25 ~~26~~. The method of claim 21, further comprising determining a utility of an interaction in accordance with a time cost of an interaction.

26 ~~27~~. The method of claim 26, further comprising generalizing a conversion of steps to an effective total time of an interaction, wherein frustration is captured by increases in an effective total time of specific steps.

27 ~~28~~. The method of claim 26, further comprising a pre-computation that is performed to yield, $p(\text{xfer}|E,\xi)$ and $p(\text{success}|E,\xi)=1-p(\text{xfer}|E,\xi)$.

28 ~~29~~. The method of claim 26, further comprising a pre-computation of probability distributions, $p(m|E,\text{xfer},\xi)$ and $p(m|E,\text{success},\xi)$ and an expected number of steps for conditions, labeled $<m>$ and $<m'>$, respectively.

29 ~~30~~. The method of claim 21, further comprising determining an expected total wait time with continuing an automated interaction, t^a at respective points in a dialog under uncertainty in failure as:

$$t^a = p(\text{xfer}|E,\xi)\ (t(<m>) + w) \\ + (1 - p(\text{xfer}|E,\xi))\ (t(<m'>).$$

wherein a wait time associated with a courteous immediate transfer into a queue for interacting with a human operator is w.

30 ~~31~~. The method of claim 30, further comprising determining a utility of call handling as follows:

$$\textit{Utility of call handling} = p(\text{xfer}|E,\xi)\ u(t(n)+t(<m>) + w),\ C) \\ + (1 - p(\text{xfer}|E,\xi))\ u(t(n)+t(<m'>).$$

31 ~~32~~. The method of claim 31, further comprising determining the utility of call handling as follows:

Utility of call handling =

$$1\text{-}p(\text{fail}|E,\xi)\ (p(\text{xfer}|E,\xi)\ u(t(n)+\mathrm{t}(<m>) + w,\ C,\ \text{success}) +$$

$$(1 - p(\text{xfer}|E,\xi)(u(t(n) + t(<m>),0,\ \text{success})$$

$$+\ p(\text{fail}|E,\xi)\ u(u(t(n)+\mathrm{t}(<m>),0,\ \text{fail}).$$

32 ~~33~~. The method of claim 32, where cost of handling the call with a human operator *C* depends on needs or goals of the caller, and is inferred from evidence.

33 ~~34~~. The method of claim 32, further comprising determining expected costs via inference of a probability distribution over Cost given evidence gathered so far, $p(C|E,\xi)$.

34 ~~35~~. The method of claim 21, further comprising providing online sensing of current wait times for calls being transferred to a human operator.

35 ~~36~~. The method of claim 21, further comprising at least one of: creating an end-to-end system that continues to at least one of log, monitor, and build models; and

automatically setting parameters, generating reports, and generating traces, for validation and auditing of actions.

36 ~~37~~. The method of claim 21 supporting an application including at least one of touch-tone routing and speech recognition.